

Satellite Data & Flight Planning Tools from GSFC-UMD-Ames

Anne Thompson

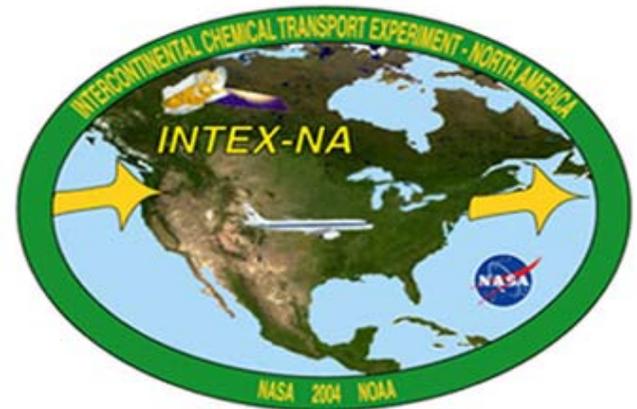
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NASA/GSFC**

Ken Pickering, UMCP

**Lenny Pfister,* R. Selkirk,
NASA/Ames**

*** Poster**



INTEX Science Team Meeting,
Virginia Beach, Mar 05

Presentation

- Website – Data Types for Analysis (AMT)
 - <http://croc.gsfc.nasa.gov/intex>
- Satellite Data (AMT)
 - Example of Met Product Use
 - Example of Aerosol Use
 - Convective Influence (LP – Poster)
- Considerations about Lightning Data (KEP)
 - 12/7, 25/7 – Illustrations
 - Collaborative Plans



INTEX-NA (INTERcontinental chemical Transport EXperiment - North America)

Mission Planning Images: A NASA/NOAA Aircraft Mission

Products available on this site are provided by Anne Thompson (PI) and Co-Investigators - K. Pickering, L. Pfister, R. Selkirk, J. Witte and T. Kucsera

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To retrieve analyses for the day of interest:

Select Year, Month, Day, Hour (GMT) and Forecast hour of interest from the following pull-down menus, then click the **SUBMIT** button below.

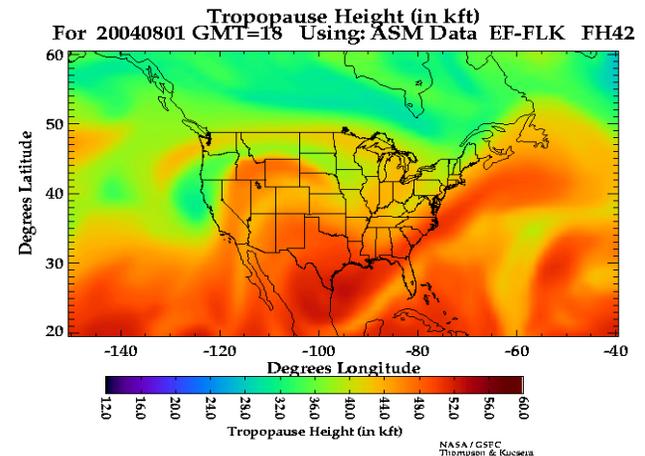
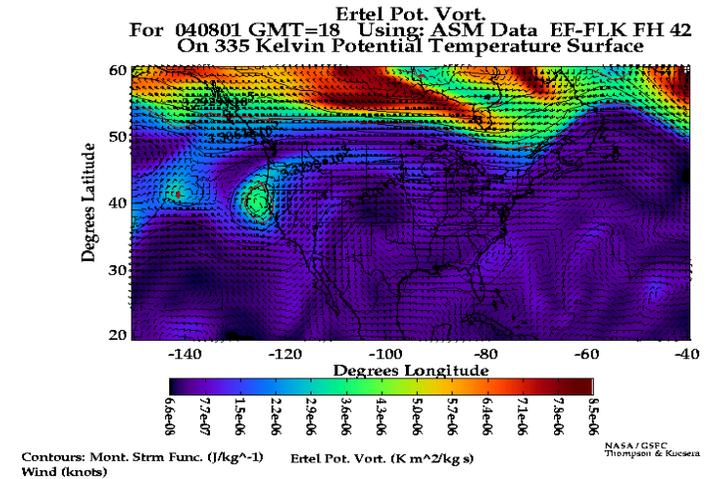
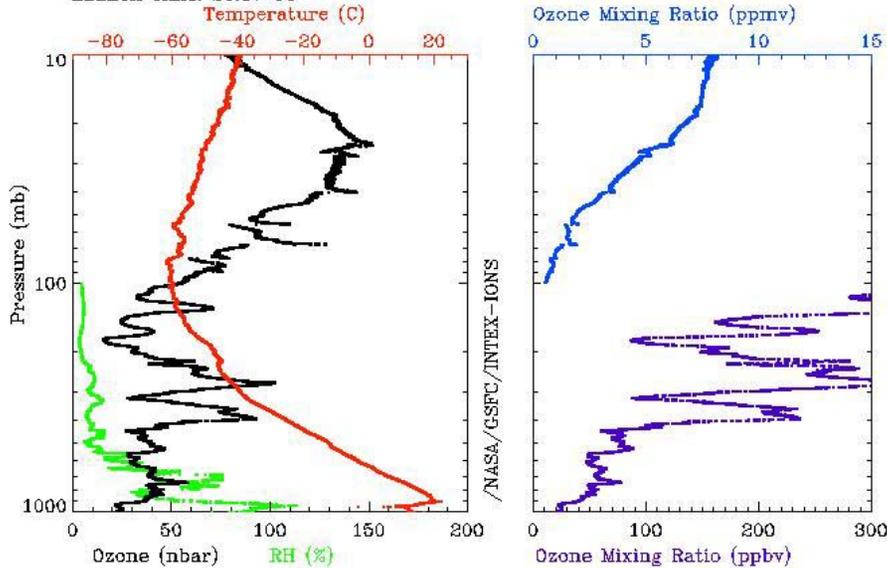
Year: Month: Day: Hour: Forecast:

SUMMARY OF MODEL PRODUCTS AND ANALYSES FOR INTEX

Product	Image Labeled in Archive as:
Air Parcel Exposure to Aircraft Products	Fuel, NO _x , HC, CO [kg/day] EAYYYMMDDHH_FHXX, Press sfc's = 700,500,300 hPa, and also on theta sfc's = 325,340 K
Lightning Exposure	ELYYYMMDDHH_FHXX, Press sfc's = 500,300 hPa, Theta sfc's = 325, 340 K
Dust Exposure	EDYYMMDDHH_FHXX, 850,700,500 hPa pressure sfc's
Reverse domain fill - Ertel's Potential Vorticity	RDYYMMDDHH_FHXX, on Theta sfc's= 325, 340 K
Tropopause Height (Kf)	THYYMMDDHH_FHXX
Ertel's Pot. Vort., Mont. Strm. Func, Winds	PTYYYMMDDHH_FHXX, on Theta sfc's = 360, 355, 350, 345, 340, 335, 330, 325 (K)
Temp. field, Geopotential Ht, Winds	PPYYMMDDHH_FHXX, on Press sfc's = 925, 850, 700, 500, 300, 250 (hPa)
Relative Humidity images	SPHYYYMMDDHH_FHXX, on Press sfc's = 925, 850, 700, 500, 300, 250 (hPa)
Cloud Mass Flux images	CDMSYYMMDDHH_FHXX, on Press sfc's = 850, 700, 500, 300 (hPa)
Detrainment Cloud Mass Flux images	CDDTYYYMMDDHH_FHXX, on Press sfc's = 850, 700, 500, 300 (hPa)
Area Field of Kinematic 5-day Back Trajectories	BFYYMMDDHH_FHXX, on Press sfc's= 850,700,500,300 hPa, Theta sfc's=325,340 K
Regional TOMS Aerosol Index images	TNYYYMDD, Daily images
Global TOMS Aerosol Index images	TSYYMDD, Daily images
Regional Lightning Count images	LNYYMDD, Daily images
Vertical Curtain Plot along flight path	CPYYMMDDHH_FHXX
Kinematic 5-day Back Trajectories for Flight Path	BTYYMMDDHH_FHXX

Meteorological Fields from GMAO – EPV (335K), Trop. Height – 1 August STE – Cutoff Low – Trinidad Head

INTEX-IONS Site: Trinidad Head, CA (41N, 124W) TO3 (SBUV) = 330(32)
Launch Date: 1 August, 2004 TO3 (CMR) = 342(44)
Launch Time: 20:07 UT



Analyze with INTEX GMAO fields:

<http://croc.gsfc.nasa.gov/intex>

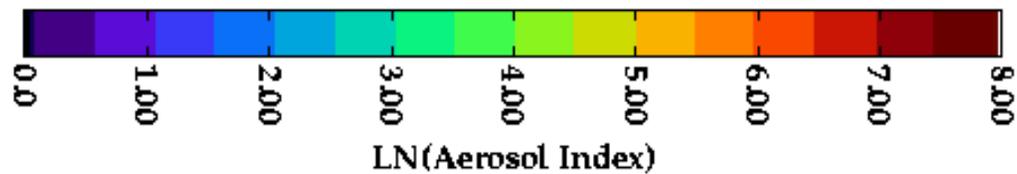
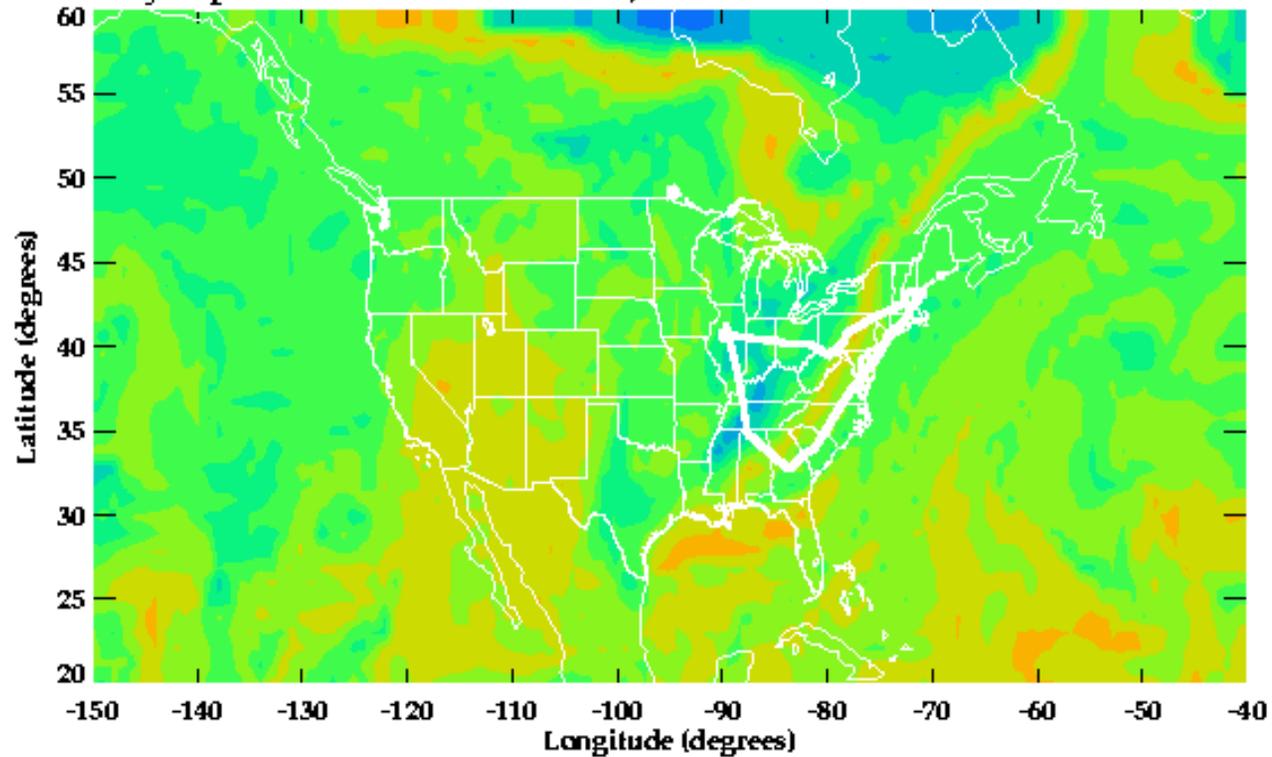
Images at ICARTT archive.

Data POC – tlk@croc.gsfc.nasa.gov

Trajectory-based Exposure/Influence Products

- **Back trajectories (5 days) computed from grid of points in flight area (kinematic and isentropic)**
- **Aerosol exposure (from TOMS AI) – initialize trajectories, run over 5-days**
 - Accumulate influence & display
 - 850, 700, 500 hPa
- **Convective influence – trajectory run until intersects deep convective cloud (based on GOES-IR imagery)**
 - Location of influence
 - Storm location, elapsed time displayed
- **Lightning exposure – Grid NLDN CG flashes hourly**
 - Trajectories run through the NLDN grids and flashes are accumulated along trajectories
 - Plot total over 5 days

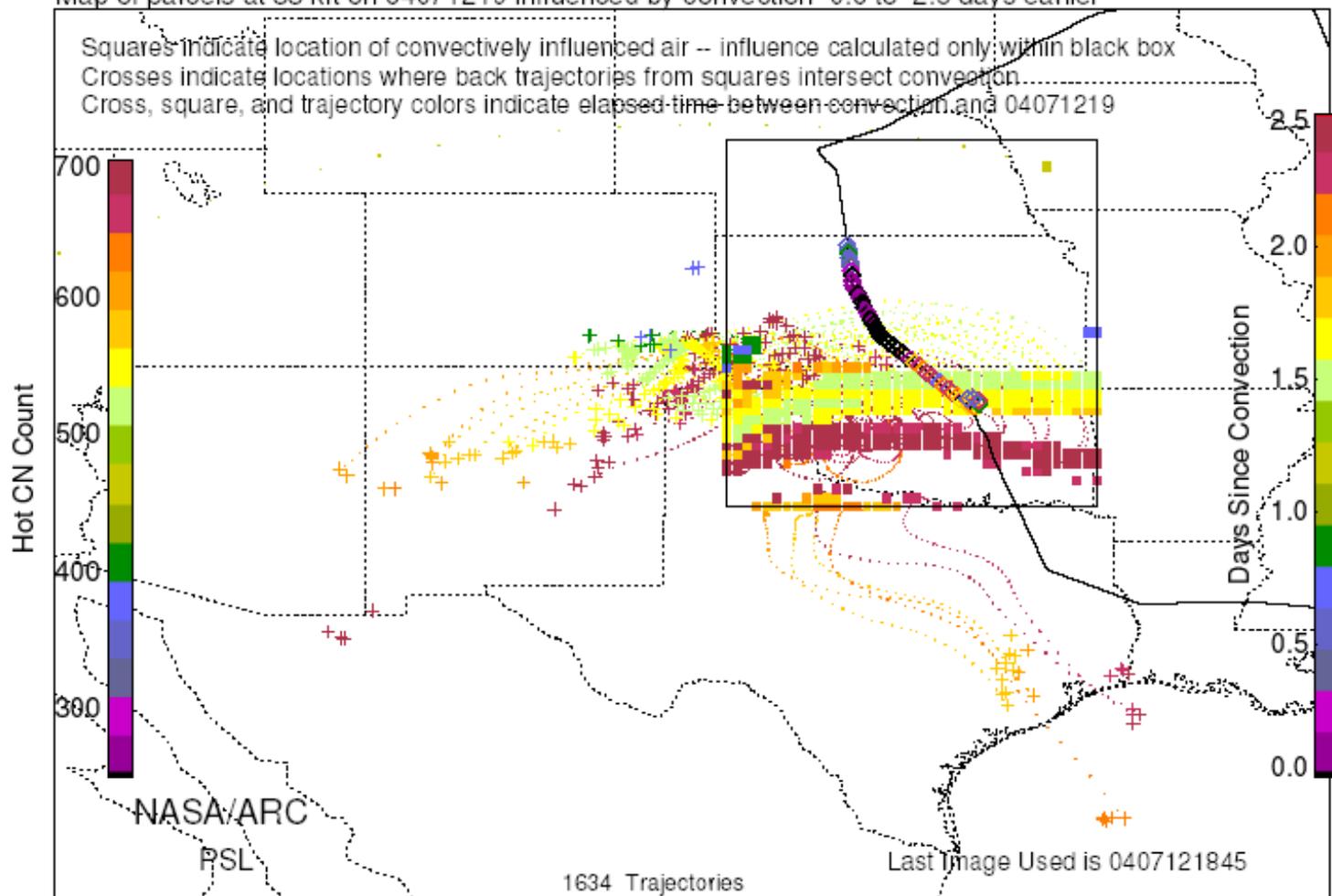
5-day Exposure to TOMS Aerosols , 20040720 18GMT Press. Level=700 hPa



NAS A/GSFC/916/kinetic/TK

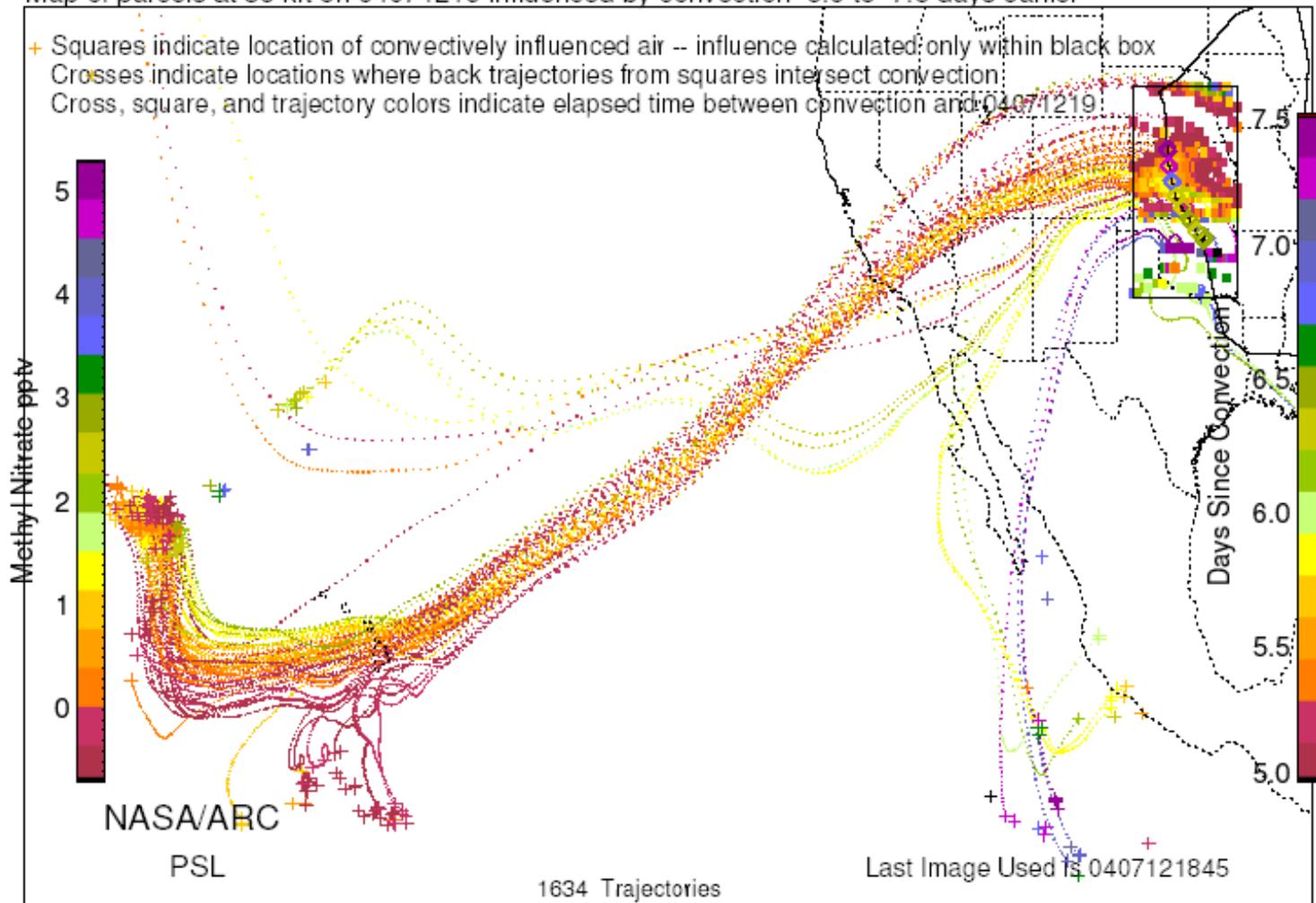
DC-8 flight path (in white)

Map of parcels at 33 kft on 04071219 influenced by convection 0.0 to 2.5 days earlier



Map of parcels at 33 kft on 04071219 influenced by convection 5.0 to 7.5 days earlier

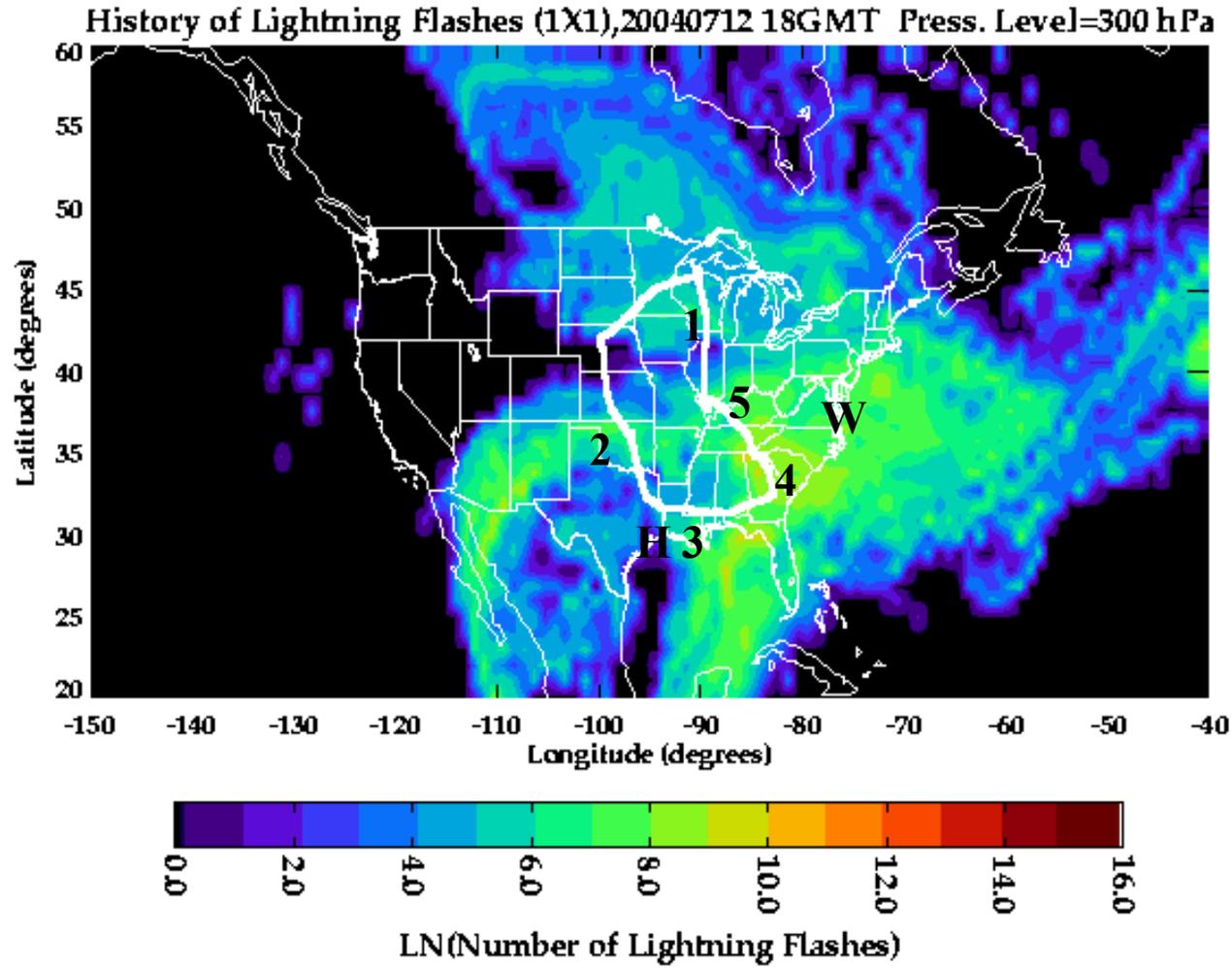
- + Squares indicate location of convectively influenced air -- influence calculated only within black box
- Crosses indicate locations where back trajectories from squares intersect convection
- Cross, square, and trajectory colors indicate elapsed time between convection and 04071219



CAVEAT

- **NLDN cloud-ground (CG) flashes are being used as a proxy for total lightning.**
- **However, intracloud (IC) lightning exceeds CG lightning by a factor of 3 over the continental US (Boccippio et al., 2002).**
- **The IC/CG ratio is highly variable by region (approx. 1 – 10) and by individual storm (even larger range).**

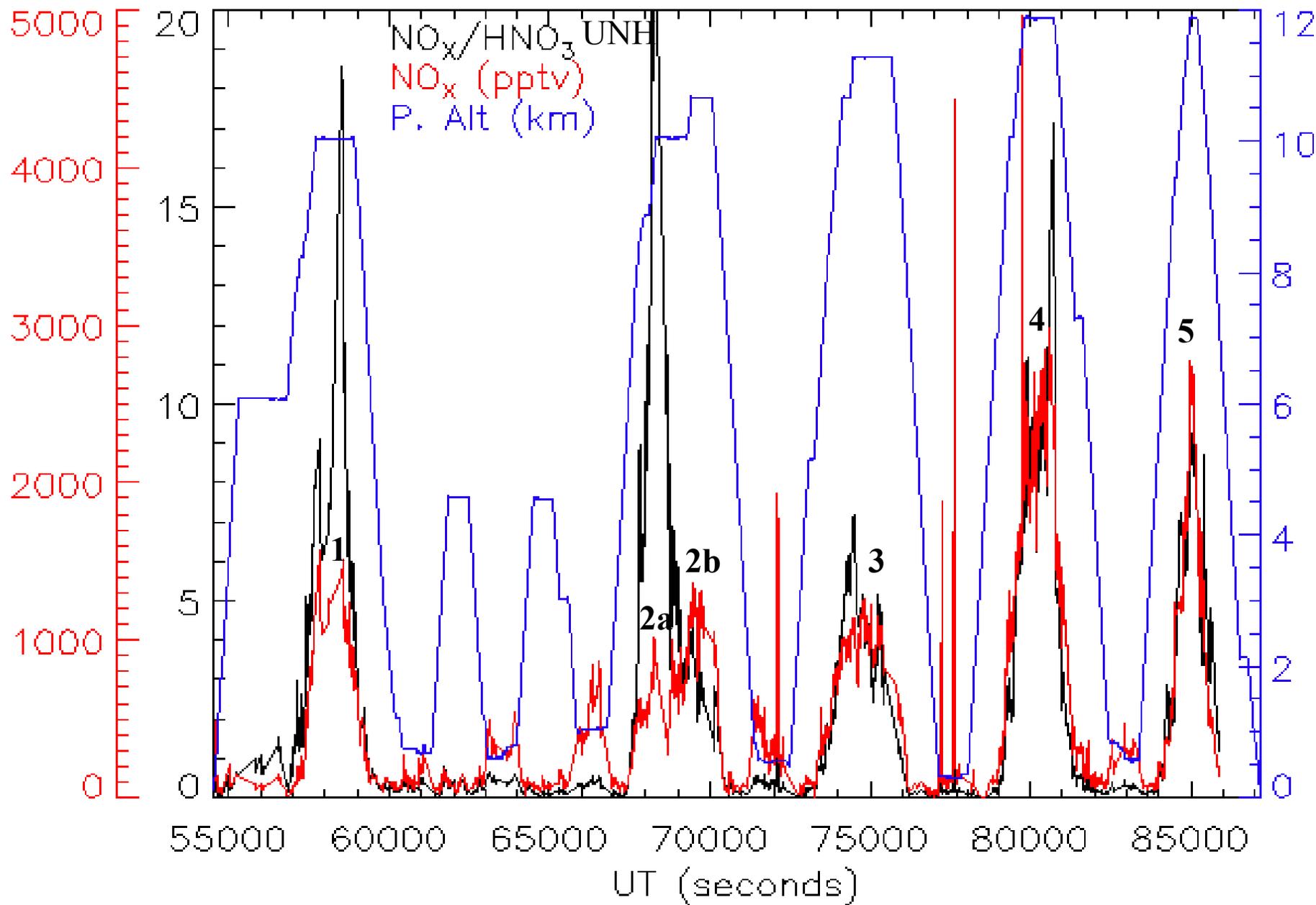
Good correspondence of 5-day lightning influence and enhanced UT ozone



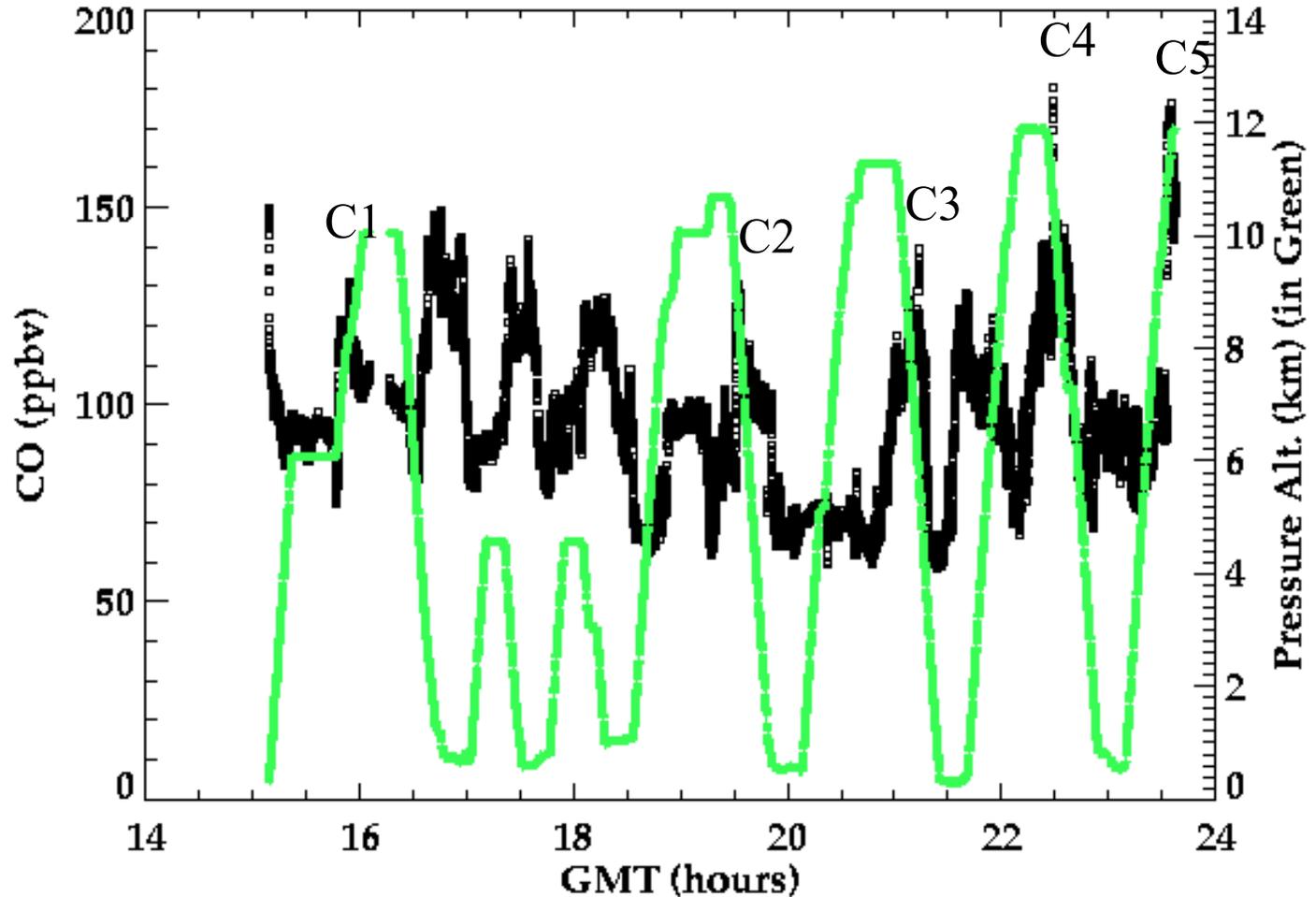
NAS A/GSFC/916/kinetic/TK

DC-8 flight path (in white)

DC-8 July 12, 2004

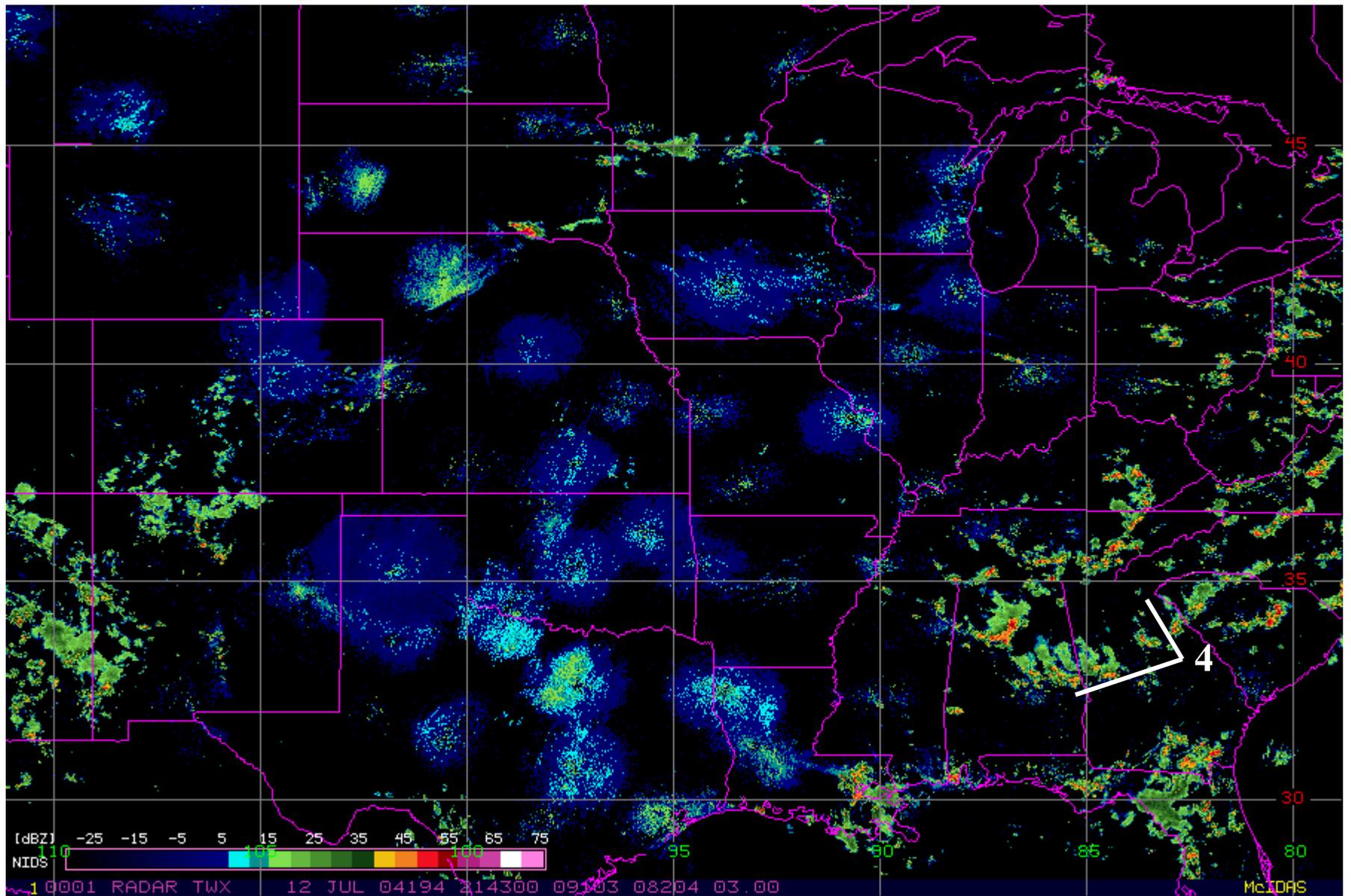


INTEX-NA DC-8 flt#7, 2004-07-12

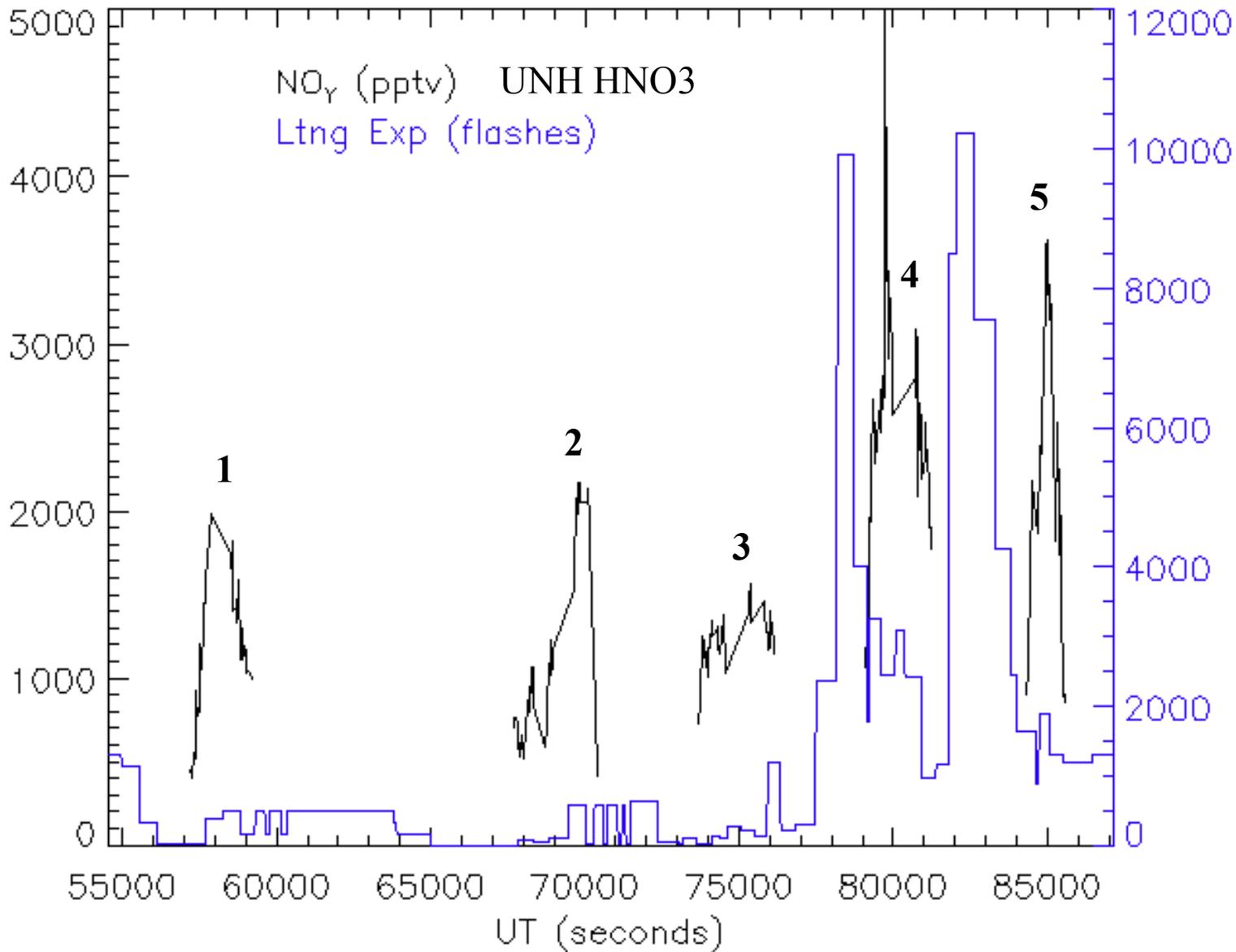


C – Convective influence

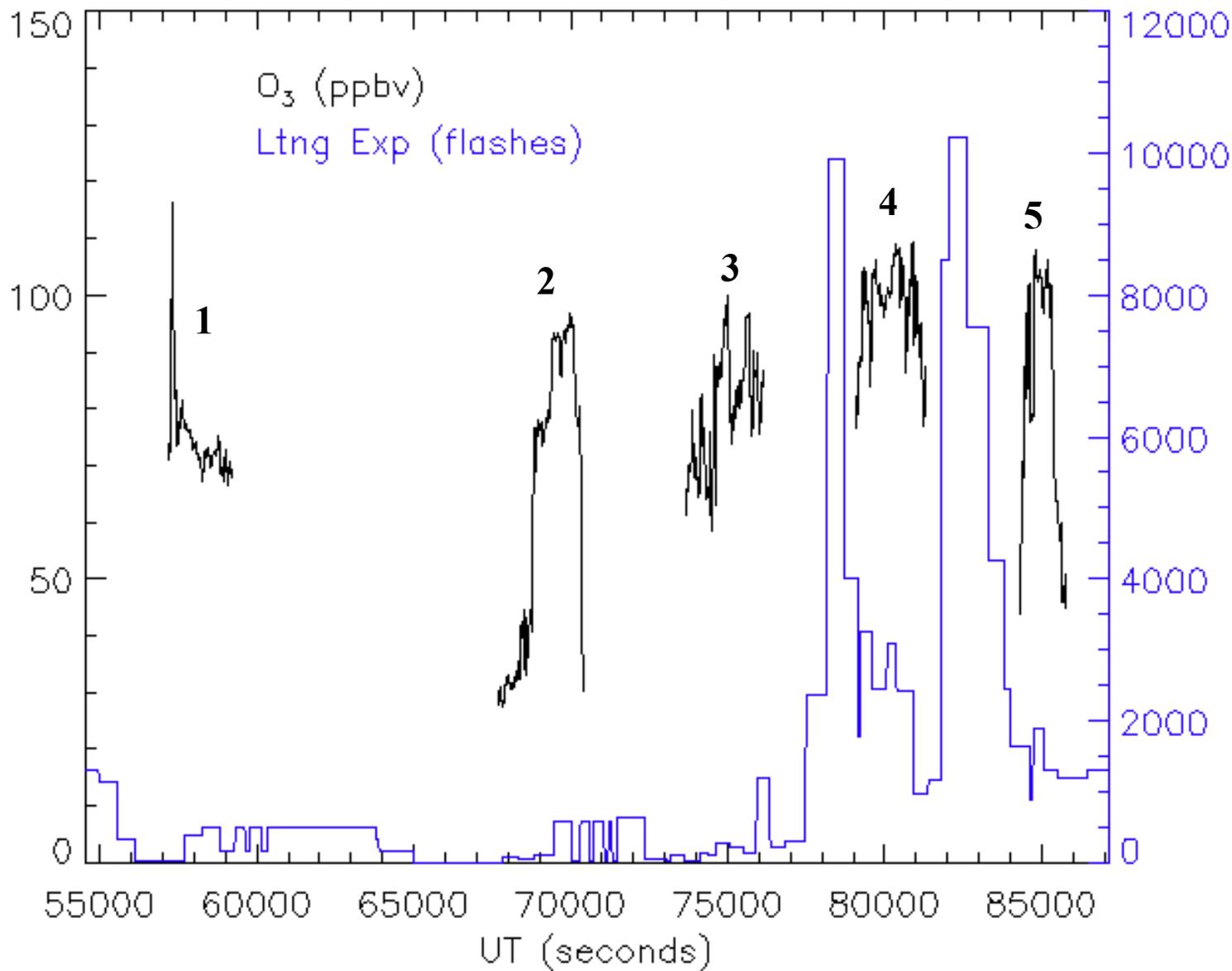
Note CO peaks are at lower altitude than NO_x peaks



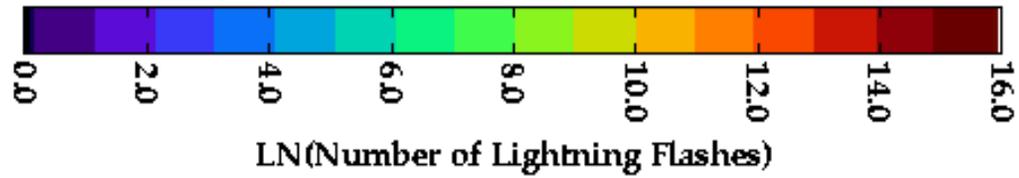
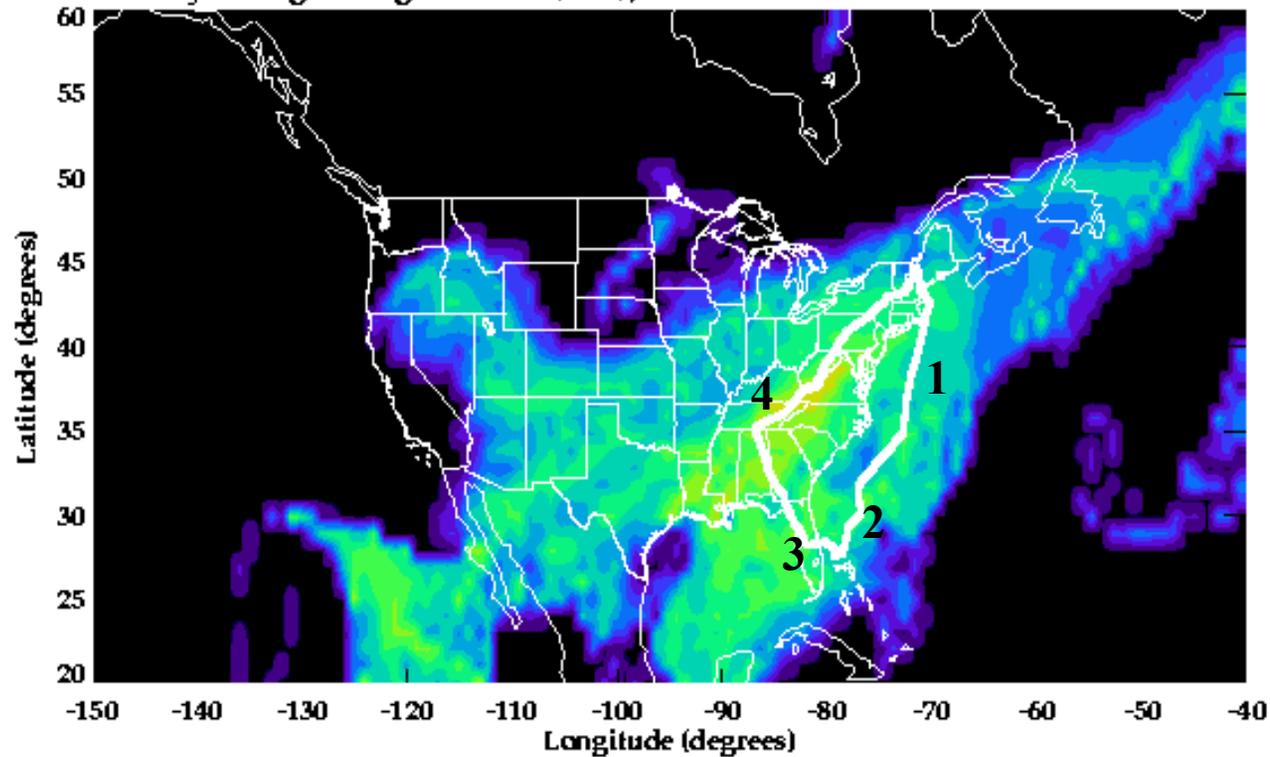
DC-8 at > 8 km July 12, 2004



DC-8 at > 8 km July 12, 2004

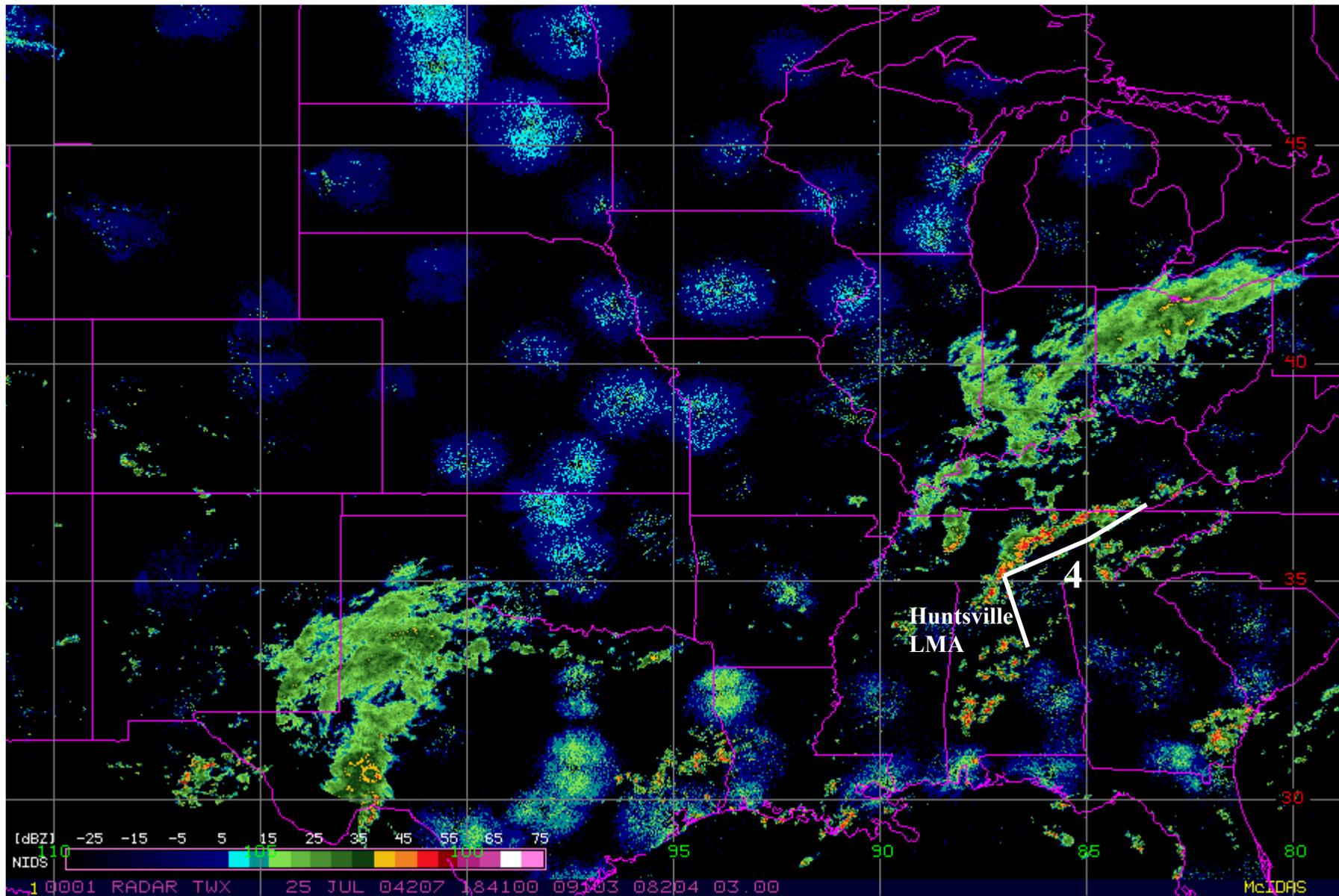


History of Lightning Flashes (1X1),20040725 18GMT Press. Level=300 hPa



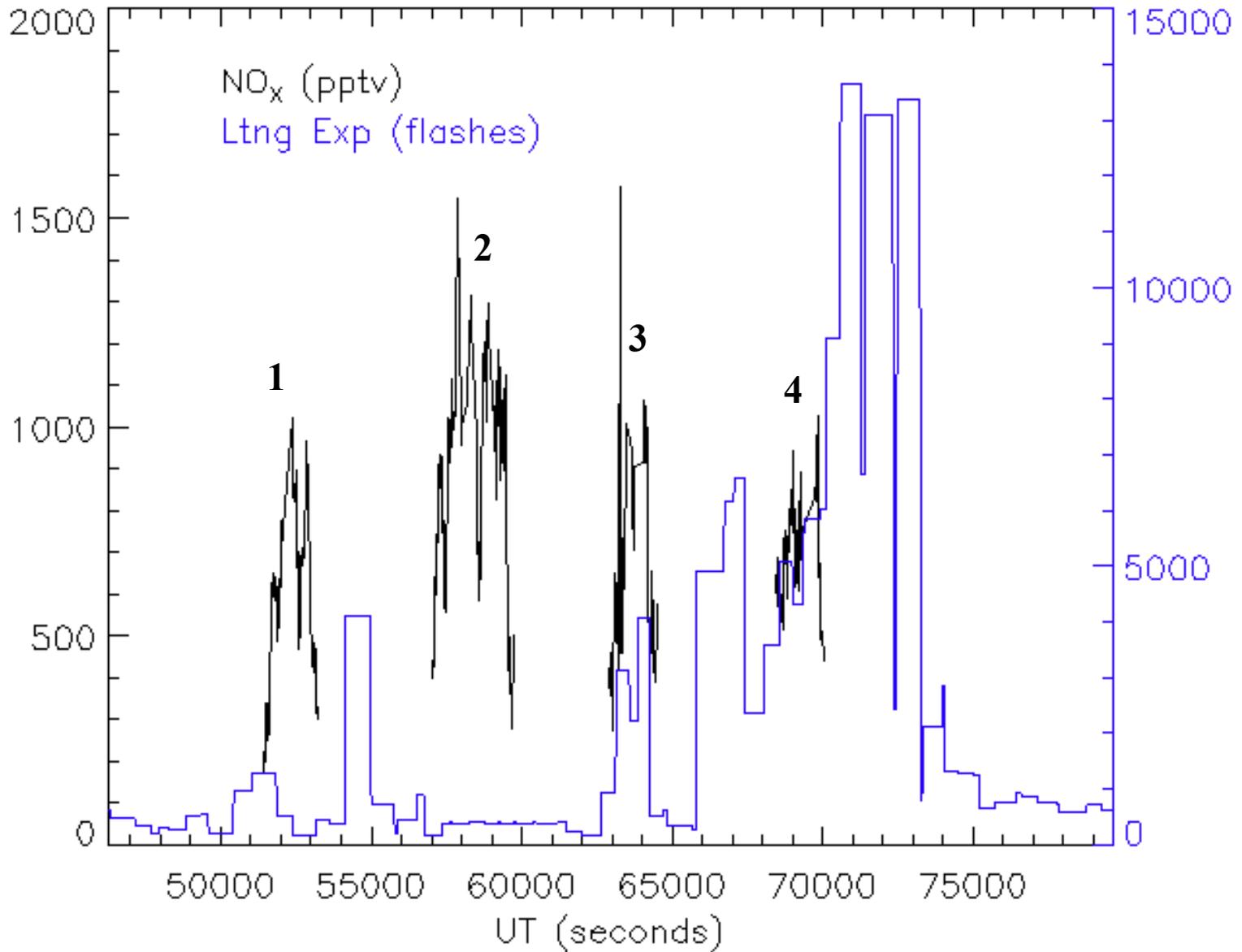
NAS A/GSFC/916/kinetic/TK

DC-8 flight path (in white)



DC-8 at > 8 km

July 25, 2004



Many Uncertainties Concerning Lightning NO Production in Regional/Global Chemical Transport Models: Can INTEX Data Help?

Analysis of DC-8 Data:

- What does the vertical profile of lightning NO_x look like at the end of a storm?

Using Huntsville LMA/Cloud model

- What is the average number of molecules of NO produced per flash or per unit flash length?
- Is NO production in cloud-to-ground flashes different from that in intracloud flashes?

Forthcoming Analysis and Modeling

Analyses

- Estimate lightning contribution to observed NO_x using ratios to CO and other tracers of boundary layer air (e.g., ethane, ethyne) - collaboration with Porter/Fuelberg)
- Estimate vertical profile of lightning NO_x using data from DC-8 ascents and descents. (collaboration with Porter/Fuelberg)
- Analyze lightning exposure relative to convective influence (work with Lenny Pfister)
- Evaluate GEOS-4 convection using NLDN data and convective influence analysis

Forthcoming Analysis and Modeling

Modeling

- Run cloud/chemistry model with lightning for cases of active convection near DC-8 flight track to estimate required NO production per flash to yield observed NO_x and relative importance of IC and CG flashes.
- Run regional/global chemical transport model (UMD-CTM) to test lightning flash rate and NO parameterizations using NLDN, DC-8 NO_x observations, and SCIAMACHY NO₂ columns.
- Estimate lightning contribution to NO_x, NO_y, O₃ in the INTEX region